THE ROCKY MOUNTAIN FOREST EXPERIMENT STATION

A LEAFLET FOR PUBLIC INFORMATION

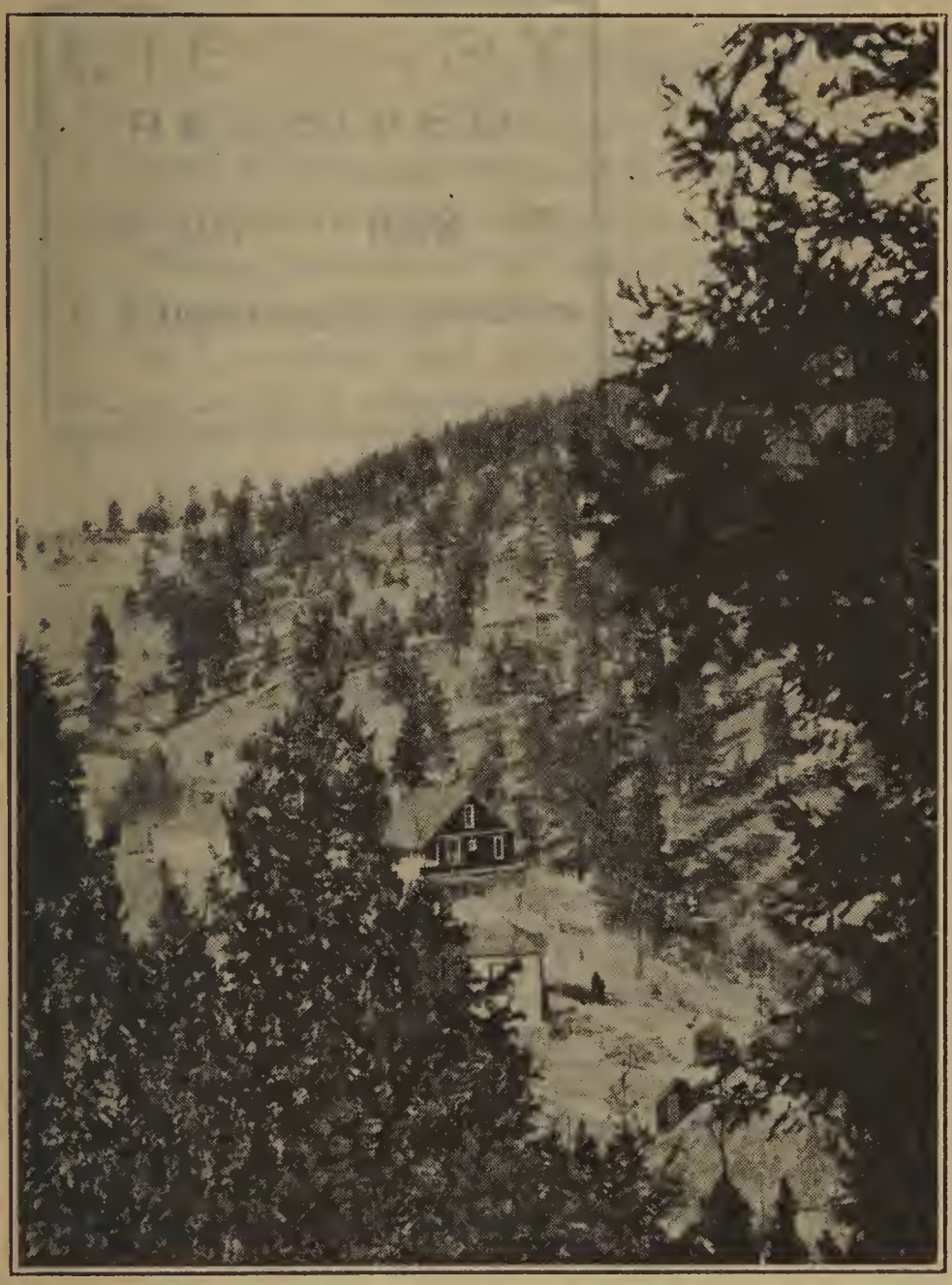


Photo by H. L. Standley

Fremont Field Station (Mount Manitou)

UNITED STATES
DEPARTMENT OF AGRICULTURE
FOREST SERVICE

WASHINGTON : GOVERNMENT PRINTING OFFICE : 1926

THE Rocky Mountain Forest Experiment Station, supported by the Federal Government and conducted by the Forest Service of the United States Department of Agriculture, studies the problems connected with growing forest tree crops, chiefly in the central Rocky Mountain region.

Field investigations are carried on to determine the methods by which forest lands may be restocked with a new crop of forest trees in the shortest possible time after the old crop is harvested and to determine the best methods of establishing a forest growth on lands not now productive.

Laboratory experiments seek out the effects of soil, moisture, and climate on the growth of different species of forest trees. Such scientific knowledge helps the forester to judge what is best to plant under certain conditions and what species may be expected to restock by natural processes an area where the climate and soil conditions have been altered by cutting or by some other cause such as fire or windfall.

Washington, D. C. Issued April, 1926

THE ROCKY MOUNTAIN FOREST EXPERIMENT STATION

A LEAFLET BY THE FOREST SERVICE

Why We Have Forest Experiment Stations

The best estimates the Government has been able to make indicate that the people of the United States are using wood four times as fast as they are growing it. Every year 22 billion cubic feet is used and only about 6 billion feet grown. Though one may still buy all he wants if he has the money, the beginning of the timber famine is already at hand, as shown by the steadily rising prices of lumber, paper pulp, and other wood products.

The question no longer is "What will posterity do for lumber and other forest products?" but "What shall *we* do?"

Fortunately, wood can be grown, like food and textile crops. It is not exhaustible in the same sense as the reserves of coal and oil. But, though Nature is bounteous and would replace most natural forests if given a chance and plenty of time, she can not be depended on to grow the forests where they will be most useful to man, of the kinds which will be most useful, and in the greatest possible quantity. Nature's processes are both deliberate and wasteful.

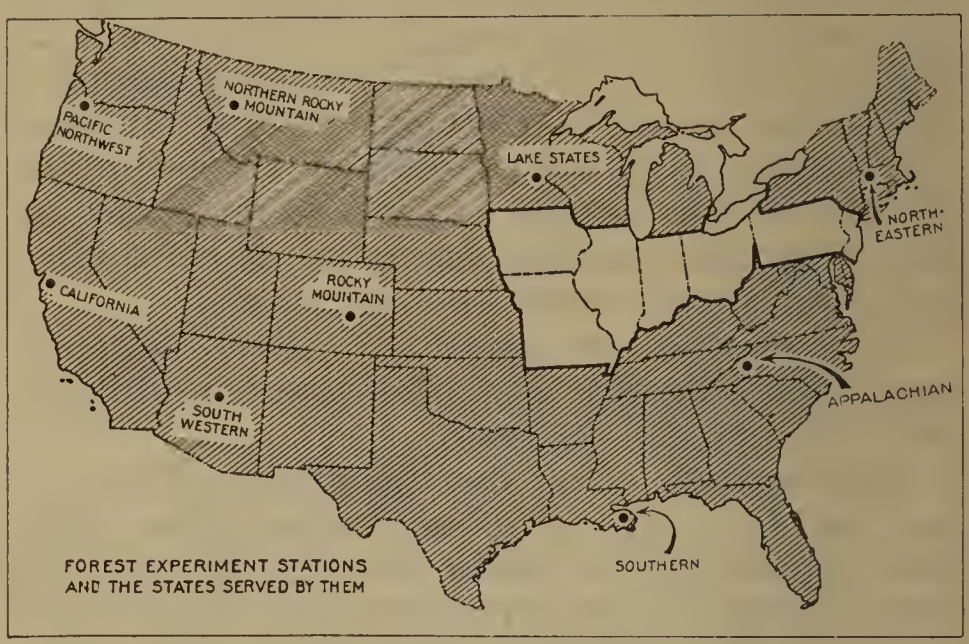
It is therefore the concern of every man, woman, and child that at least enough forest trees shall be grown to supply wood for the purposes which only wood can serve. In undertaking to assist in reforesting the timberlands of the Nation, the Federal Government, through the Department of Agriculture, assumes a responsibility on behalf of all the people. To be sure, the land actually controlled by the Federal Government could not grow more than one-fifth of the wood needed at present; but the Government may by experiment and the working out of efficient forest practices set an example and provide information for all the other owners of forest land, so that they, too, will know how to produce the most and the best that is possible.

Forest experiment stations serve a purpose similar to that of agricultural experiment

stations in other branches of the department's activities. They assist in finding out in the laboratory and under controlled conditions in the forests the facts about tree growth that will make it possible for land-owners, whether public or private, to grow bigger, and more profitable crops of trees.

A Chain of Forest Experiment Stations

In the endeavor to study all forest regions, a chain of forest experiment stations has gradually been built up, not yet complete or of equal strength in all its links, but already of practical and increasing value to each region covered.



The importance of the areas can not in every instance be judged by size. The central eastern region, not provided for, is a great consumer of timber, but is at present practically denuded of forests

In the Rocky Mountain region as a whole there are three forest experiment stations: One at Missoula, Mont., covering northern Idaho and eastern Montana; one at Flagstaff, Ariz., serving the Southwest; and the one here described.

In the Pacific Northwest is a well-established station whose principal problem is the growing of Douglas fir on both private and national forest lands. A similar station in California was authorized by Congress in 1925 and established in 1926 to study the marvellous redwood and the very valuable sugar pine and yellow pine forests of the coast and mountain regions of that State.

Another station is established at New Orleans for the entire southern pine region, from which have come our true yellow or "hard" pine, as well as our naval stores during the past half century, and in which may still be grown vast quantities of this material. In the heart of the Southern Appalachians, with their valuable oaks, hickories, and yellow poplar, and also with their problems of streamflow

and water power, is another station, located at Asheville, N. C. In New England a station at Amherst, Mass., studies, first of all, the means by which the northern spruce lands can be made more productive of pulpwood, so that the dense population of the Northeast may continue to have its newspapers, and all of the country its periodicals, at reasonable cost.

F-36787-A

A carpet of little trees planted 50 at a time with transplant-boards, to develop suitable stock for use on forest lands

A station at St. Paul studies methods by which the sandy lands of Minnesota, Wisconsin, and Michigan, lately logged clean and then repeatedly ravaged by fire, may again be made to grow white pine, Norway pine, and even the lowly jack pine. Have you ever wanted a light, clear, clean, straight-grained piece of wood to work into something useful? If you have, then you know that it's a worthy purpose to guarantee to posterity even a few white pine trees. The "unlimited" stands of white pine of 1850 are now, practically speaking, extinct.

The Rocky Mountain Forest Experiment Station

The Rocky Mountain Forest Experiment Station, with headquarters at Colorado Springs, serves the mountain territory of Colorado and Wyoming, the Black Hills region of South Dakota, and the plains region just east of the Rockies, including the sand hills of Nebraska, where extensive forest planting is being carried on.

Only a part of the experimental forestry work necessary in this large area can be done at a central point. The studies necessary to determine how fast forests grow, how this

growth is affected by thinnings and removal of timber trees, and what care must be exercised to keep the forests always stocked with young trees, are carried on throughout the region on a number of small areas called "experimental plots." This is necessary, because all of these features vary considerably according to soil and climate.

A Region Full of Forest Problems

If, in traveling about, you observe even a slight change in the color of the rocks, you may also note in nearly every instance that the character of the forest has changed. The problems encountered in attempting to plant trees on a large scale are different in each locality, those of the Nebraska sand-hill region being very different from those which make planting of burned areas in the mountains difficult.

F-20600-A

Thousands of acres devastated by fire must be planted with small trees like those in the preceding picture if the productivity of our forest land is to be renewed

The experimental plots must be placed where the respective problems can best be studied. The growth of lodgepole pine and the various measures necessary to make lodgepole pine forests most productive for supplying railroad ties or other forest products may best be studied in southern Wyoming, while a similar group of studies affecting Engel-

F-25636-A

In the Nebraska sand hills a thousand acres annually are being turned into forest land by the planting of small tree seedlings

mann spruce are pursued in the highest mountain country of central Colorado. In the Black Hills region of South Dakota yellow pine is the tree under observation.

In addition to the studies which deal directly with timber growing, the problem of stream-flow regulation by forests is important, because of the dependence of the farmers in this region upon the mountain streams for irrigation. In 1910 a special branch station was established at Wagon Wheel Gap, Colorado, to determine exactly how much influence the forest has on the amount and regularity of stream flow, the erosion of the mountain sides, etc. Here the United States Weather Bureau is cooperating

F-94267

Wagon Wheel Gap—the effects of forests upon stream flow and erosion have been studied here since 1910

with the Forest Service to make this study very thorough.

Finally, small plots are needed at a great many points in the national forests to study the effects of grazing on young trees and to determine how much grazing can be permitted without endangering the continuous production of timber.

From this brief sketch it will be seen that the work of the Rocky Mountain Experiment Station is of great variety, and that only a few special phases of it can be demonstrated at the Fremont field station, even though these be extremely important phases.

F-95117

Approach to the Fremont field station

The Fremont Field Station on Mount Manitou

The Fremont field station and plant was established on Mount Manitou in 1909 at an elevation of 8,850 feet. It is called the "Fremont Station" in honor of General Fremont, an early explorer, whose trail to the summit of Pikes Peak passes through the station grounds. Beside this trail, and of about the same age, is the only native lodgepole pine on the grounds and one of the few in the Pikes Peak region. Did some one in the General's party pick up a cone north of the Platte River, only to drop it here when his curiosity had been satisfied?

The work of the Fremont Station is mainly that of a central laboratory to which baffling problems encountered elsewhere are referred. Also some of the experimental plots already referred to are located here. The Forest Service aims to have from each individual acre of the 160 acres within the station grounds a record of the tree growth which takes place. These acres are marked off by the 4 by 4

white posts which may be seen in almost any direction.

The record of growth is obtained by making a tally of all the trees on an acre, by sizes, about every 5 years. The "yardstick" most used by foresters is the diameter-tape, with which the girth of the tree at a point 4½ feet above the ground is measured to determine the average diameter.

F-201825

Just inside the station gate the path leads past these graceful open-crowned blue spruces

To obtain the best forest growth, some timber must from time to time be eliminated. Such trees are cut and used for fuel. This permits the utilization of every old tree as soon as its growth ceases to be profitable, and also of young trees where they occur too thickly to grow well.

86045—26†——2

The Out-of-Doors Laboratory

The visitor will best get an idea of "what the experiment station does" by considering the various parts of the station plant.

In coming up from the gate, you may have noticed on the open hillside to your right several blocks of small pine trees in regular rows. That open land was used in 1910 and 1911 for experiments on the problem which was most pressing at that time, namely, how best to establish new forests in the Pikes Peak region. The few small plots of trees which you now see are the net result of a few successes and many failures. The successes were mostly obtained by planting trees which had been grown in a nursery for 3 years. The failures were mainly the attempts to grow trees from seed.

Considering the failures, all of the "direct seeding" methods proved more expensive than planting trees. And so it has been almost everywhere. If you ask how nature does it, it is by a million failures for one success. Nature takes years or centuries for what we want to accomplish in one year, and she broadcasts a million seeds where we must deal in thousands, because of the cost of seed collection.

On the same hillside are some younger trees which represent attempts to work out the very difficult and intricate problem, still far from solution, of where to collect seed. If you were planning to reforest Pikes Peak, would it be necessary to collect the tree seed in the Pikes Peak region, or would western Colorado seed do just as well? Perhaps seed could be collected over there for one-half the cost here. The plantations which you see are yellow pine trees grown from 10 different collections of seeds, and already they are telling us that it is best not to go farther away for the seed than is absolutely necessary. But there are still many questions as to the best sources of seed, which can not be answered until a great many trials are made.

Naturalizing Alien Trees

The attempt to acclimatize trees from other regions is often a discouraging experiment, but occasionally a most fruitful one. Many of the species which have been brought in from other regions and other countries have dried up, "burned," and been winter-killed in the winter, although they may have got along fairly well during the summer, when showers are frequent. However, in spite of the fate which has overtaken most of the species tried out, hope yet remains that somewhere there

exists a tree which, if widely planted under these conditions, would increase the rate of growth of the forest. It may be, indeed, that study will bring out a local strain that will grow faster and more widely than at present, and will be less subject to disease and insect attack, and less susceptible to drought.

Ways of Harvesting Forest Crops

On a portion of the 160-acre experimental tract, where a stand of virgin timber still survives, various methods of removing the forest are being tried out, with the purpose of finding the most economical and effective way of harvesting the timber crop and at the same time of perpetuating the forest on several million other acres of forest land in Colorado.

F-49793-A

The Fremont field station in detail—three dwellings, with weather tower in front of third; below—office, greenhouse, and dwelling

One of the most interesting facts about forestry, in contrast to most branches of agriculture, and to mining, is that one may harvest a crop of timber and have a potential crop left. Great care must be exercised, however, to see that only the "ripe" trees are cut, leaving the young trees to take their places, and depending on nature to keep a supply of young trees always pushing up under the older ones. It is nearly equivalent to "eating your cake and having it too." But it is not quite that.

In exceptional cases the young trees will not start until after the old trees have been cut. This is a delicate situation, and if, after a few years, natural seeding is not effective, it may be necessary for the forester to plant trees to keep the area productive. The

forester's art is at its best when he so manages his cutting as to obtain the best possible yield, without leaving future yields at all in doubt.

Within a short distance of the station you may see an example of this partial cutting in a Douglas fir forest. This is a plot on which all the larger trees were cut in 1913 and about 80 trees were left that with a few more years growth would yield a supply of railroad ties. In 1925 these 80 trees were removed. Under their shelter had sprung up thousands of small seedlings which were not there in 1913, and which now need all of the space for their vigorous growth.

F-185166

Under the snow are thousands of small Douglas fir seedlings, protected by the trees left from a "shelterwood" cutting 10 years ago. The seedlings are ready to fend for themselves when the older trees are cut

This experiment demonstrates that what is known as the "shelterwood" system of cutting is best suited to Douglas fir in this region; for without the shelter of the 80 larger trees, and without the seeds supplied by these trees, the small seedlings would not have come in. Instead, the ground would have been taken by aspen, which in this region is to the forest what a weed is to the cornfield.

The Station Buildings

The more prominent of the buildings of the station are the four dwellings for the members of the staff and for temporary help usually employed during the summer, the office and laboratory building, the greenhouse, and the heating plant.

Near the office building is a tower about 20 feet high on which is a shelter for thermometers, and other instruments fully exposed to the weather. This is the main weather station at

which records of weather conditions have been made since 1910. These records become increasingly valuable as long-time averages give a basis for weighing the peculiarities of any year or season, and for understanding why tree growth is rapid or slow, or why the planting of trees is successful or unsuccessful. Also, as has been pointed out, they make possible a comparison of the weather conditions of the region with those of other regions, which may reveal one reason why trees from other regions will not grow here.

Within the thermometer shelter will be found, among other instruments, the usual pair of thermometers, one of which registers the highest temperature each day and the other the lowest. A thermograph or writing-thermometer records in ink on a sheet of paper the approximate temperature at any hour of the day or night. A second pair of thermometers comprise the psychrometer. When the cloth-covered bulb of one thermometer is moistened and whirled through the air, the temperature of that thermometer is depressed by the cooling

F–201827

Weather tower and recording instruments—the observer is consulting a psychrometer—above him are a pair of evaporimeters—other equipment includes thermometers, a sunshine recorder, and an instrument for measuring wind velocity

effect of the moisture; the amount of this depression as compared with the record of the dry bulb indicates the rate of evaporation, and that in turn is a measure of the dryness of the atmosphere.

On the tower the four aluminum cups which are constantly turning are the driving mechanism of the anemometer or wind-velocity recorder. This instrument is electrically connected with an apparatus in the office which records on paper every mile of wind movement at any time of day or night. Likewise, the small glass instrument standing alone on the top of the post transmits to the office an electrical current which shows the duration of sunshine and of cloudiness. There is still another record made by the office recorder, that of wind direction. The wind-vane which shows this, however, is situated at some distance, outside of the narrow valley in which the station lies.

Other weather recorders on the tower are the evaporimeters (two nickel-plated instruments operating side by side on a slender support) which, by steadily feeding water to wicks exposed to sun and wind, permit constant evaporation. The amount of this evaporation is determined by weighing the instruments each day, and the loss in weight is a measure of the total evaporation for the day. This, of course, is greatest when the air is dry, when the wind velocity is high, and when the sunlight is particularly bright.

Many other evaporimeters, thermometers, etc., are located at a number of stations in the woods, to help in determining what conditions of the atmosphere are most favorable for each tree species. For example, on south exposures where yellow pine grows best, temperatures at the surface of the ground may be 30 to 50 degrees higher at midday than on the north exposures preferred by spruce and Douglas fir.

The Laboratory

The laboratory and office are combined in one building; but as the permanent records of experiments, the library, etc., are kept in the Federal building in Colorado Springs, and the clerical work, writing of reports, etc., are done there, the office on Mount Manitou is only such as affords facilities for making field records.

The building is used mainly as a laboratory for testing soils. The mountains present an infinite variety of soils, some very good for tree growth, others very poor. As tree crops can not be changed or rotated every year like farm crops, it is desirable that, before a crop

of trees is planted on a certain kind of soil, an attempt should be made to find out with all possible certainty what kind of trees will grow best on that soil.

F-94262

A field weather station in a Douglas fir forest

A Problem of Soils

Suppose just such a problem, and that the evidences of past timber growth are too indistinct to indicate what has grown best in this soil in the past. If a number of species are actually planted side by side on that land, at least several years must pass before it appears which tree is most promising. Also, other factors may affect the result, such as especially good or especially poor planting stock, so that one species suffers a handicap from the beginning and the test fails. By means of a laboratory test we can in a much shorter time obtain at least a good indication of what the soil is best suited for; and we can, besides, learn something about the soil itself which will be of assistance in the future.

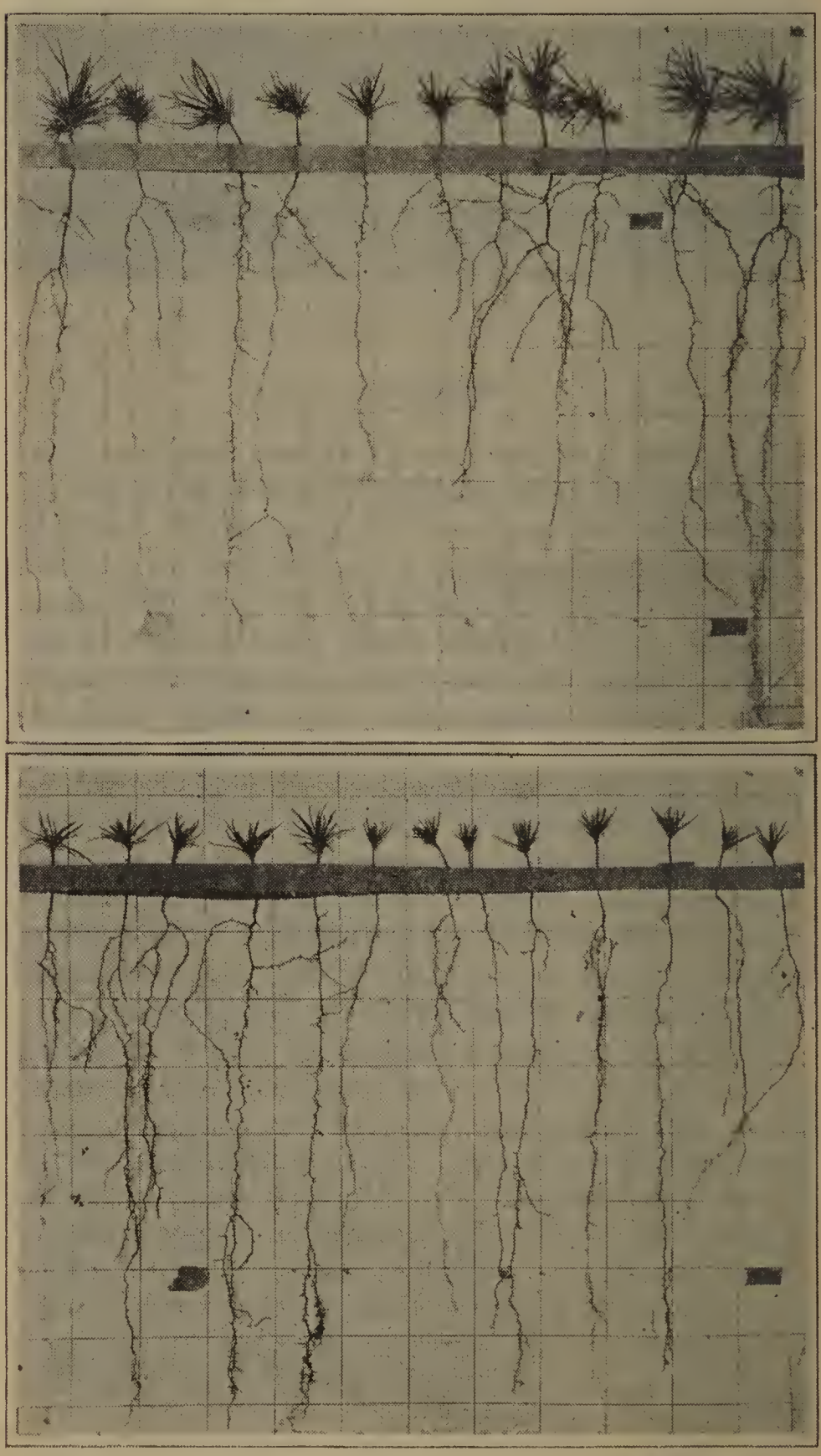
When a 50-pound sample of soil is received at the laboratory, a few comparatively simple tests will serve to classify its physical and chemical properties. By comparison with other soils which have already been studied, it may be possible to recognize very quickly some properties which make that particular soil desirable for one species and undesirable for others. It is for this testing of the soil itself, or examination of its make-up, that the laboratory is equipped.

For types of soil which have never been met before, or for those requiring greater certainty of diagnosis, the best course is to make an actual test of the growth of seedlings in the

soil. For this purpose several pots of the soil are prepared, sown with seeds of various species, and placed together in the greenhouse, where all may be kept under identical conditions.

The Greenhouse

In the greenhouse these pots, often containing a variety of soils which are being tested simultaneously, are placed on a large table, which is revolving very slowly. In the course of a day one pot of soil receives in this way just about as much sunlight as another, and no pot can become appreciably warmer than



F-160339-F-160341

Lodgepole pine seedlings quickly respond to differences in soil. The year-old seedlings in the upper series, grown in sandy soil, are twice the size of those raised in a volcanic loam (lower)

the others. No rain is allowed to fall on the pots, as some would surely get more than others. Instead, all are given measured quantities of distilled water at regular intervals. It will be seen, therefore, that all of the seedlings have equal opportunity to succeed.

F-170628-F-170629

Western yellow pine seedlings grown in a poor sandy soil (upper series) develop long roots and thus, by a curious anomaly, can better withstand drought than those planted in a richer soil (lower series). The latter have no occasion to root deeply and are unable to reach the lower water table

The seeds begin to germinate within two weeks of the time they are placed in the soil. As they are kept warm and receive sunlight throughout the winter, they grow during the entire year, no matter at what season the test may be started. At the end of a year exactly, they are carefully removed, washed out with a stream of water in case the soil does not easily separate from the roots, and measured, weighed, and photographed—roots and all. From the color of the seedlings, their weight, and the quality of roots produced, one may judge whether the soil has suited their needs.

Testing for Good Seed

Another purpose for which the greenhouse is used is to test the sprouting ability of different lots of tree seeds. For example, a forest nursery may be required to produce two or three years from to-day a million trees of a certain kind, and of a size suitable for mountain planting. The first thing which the nurseryman must know is how many seeds or how many pounds of seed to sow in order to be sure of having a million little trees, for sometimes seed crops contain as much as 60 per cent of sterile seed.

F-10285-A

The interior of the greenhouse, where as many as 150 separate germination tests have been in progress at one time

In the greenhouse this testing process is very simple, the only technical difficulty being that of maintaining the same temperature conditions at different times and seasons. Usually five hundred seeds are sown in one box of sand, are watered every day, allowed to reach a daytime temperature of 77° F., and cooled down to 57° at night. When in the course of a week or ten days the seedlings begin to push through the surface, they are pulled and counted. At the end of about 30 days the number pulled from any one box is footed up, and found to be, say, 325, or 65 per cent of the 500 seeds sown. It is then said that 65 per cent of the seeds are "germinable." If there are 10,000 seeds to the pound, a pound should produce 6,500 seedlings. The nurseryman will possibly cut this estimate to 6,000 or 5,000 for outdoor sowing in the nursery.

F-38325-A

Young trees in sealed pots determine the exact amount of water used by the different species

Measuring a Tree's Thirst

Once a stand of young seedlings is established on a forest area, the character of the forest for the next hundred years or more may be said to be fixed; it can be altered only in slight degree. A catalogue of the inherent qualities of the seedlings of different species is therefore of great importance to the forester, and consequently of major importance as a subject of forest research. It is important, for example, to know that the seedlings of Engelmann spruce are small and frail, and that their roots grow very slowly and consequently are easily killed by drought if the soil becomes dry 4 or 5 inches below the surface. The seedlings are also killed by exposure to excessive heat of the

F-193180

The cone-drying shed with some of the cone trays removed

sun. They will grow in deep shade, but they do not use a great deal of water.

All of these comparative qualities, except the last named, can be determined by the student who merely keeps his eyes open and his reason at work. But how much water a tree uses can be told only by measuring the amount which it withdraws from the soil. This is done in the laboratory by sealing-in a tree growing in a can of soil, so that no water can be lost except that which evaporates from the leaves. This is measured at intervals by weight, and replaced through a small tube according to the tree's needs.

Cone Drying

The air-drying shed was equipped to determine the cheapest and most effective methods of obtaining the seeds of lodgepole pine, the cones of which are very slow in opening. It was found that six months of air-drying, followed by a few hours of kiln-drying at about 150° F., opened the cones most thoroughly and gave seeds of the highest quality. But at best one must have 2½ bushels of cones to yield a pound of seed.

In the adjoining concrete fireproof building is the experimental kiln in which cones are dried by artificial heat. The kiln is operated with gasoline burners, which give a very steady heat. The air heated over these burners rises through the kiln as it would through a chimney, and in doing so warms and dries the cones spread on trays.

In the back of the same building is a room partly underground which, because of its even temperature, is used for the storage of seeds. Trees do not bear cones every year. When a good crop of cones is produced, enough seeds must be stored to meet requirements for several years, and in such a manner that the seeds will retain a high degree of vitality.

The Value of Research

This brief sketch of the station's work will give the reader an intelligent conception of the kind of problems which forestry must meet and solve in order that the practice of silviculture—in plain words, timber growing—may develop in a thoroughly scientific and efficient manner. Everywhere American industry is improving its methods and increasing its usefulness by research, employing experts to study the problems peculiar to each industry. Forestry can not be content to follow haphazard methods, or to learn only by the expensive method of

long experience. Small-scale experiments and a thoroughly scientific knowledge of the materials, the forces, with which nature builds—this is the quicker, surer course demanded of the silviculturist.

Trees of the Region

The Pikes Peak region boasts 12 species of evergreen trees and these are practically all that are found in the Central Rocky Mountains. There are no broadleaf trees of commercial importance, although the aspen or "quaking asp" with its light-colored, shiny, trembling leaves and nearly white bark adds much to the beauty of the mountain scenery. All of the other broadleaves come only to the foot of the mountains and are restricted to the canyons.

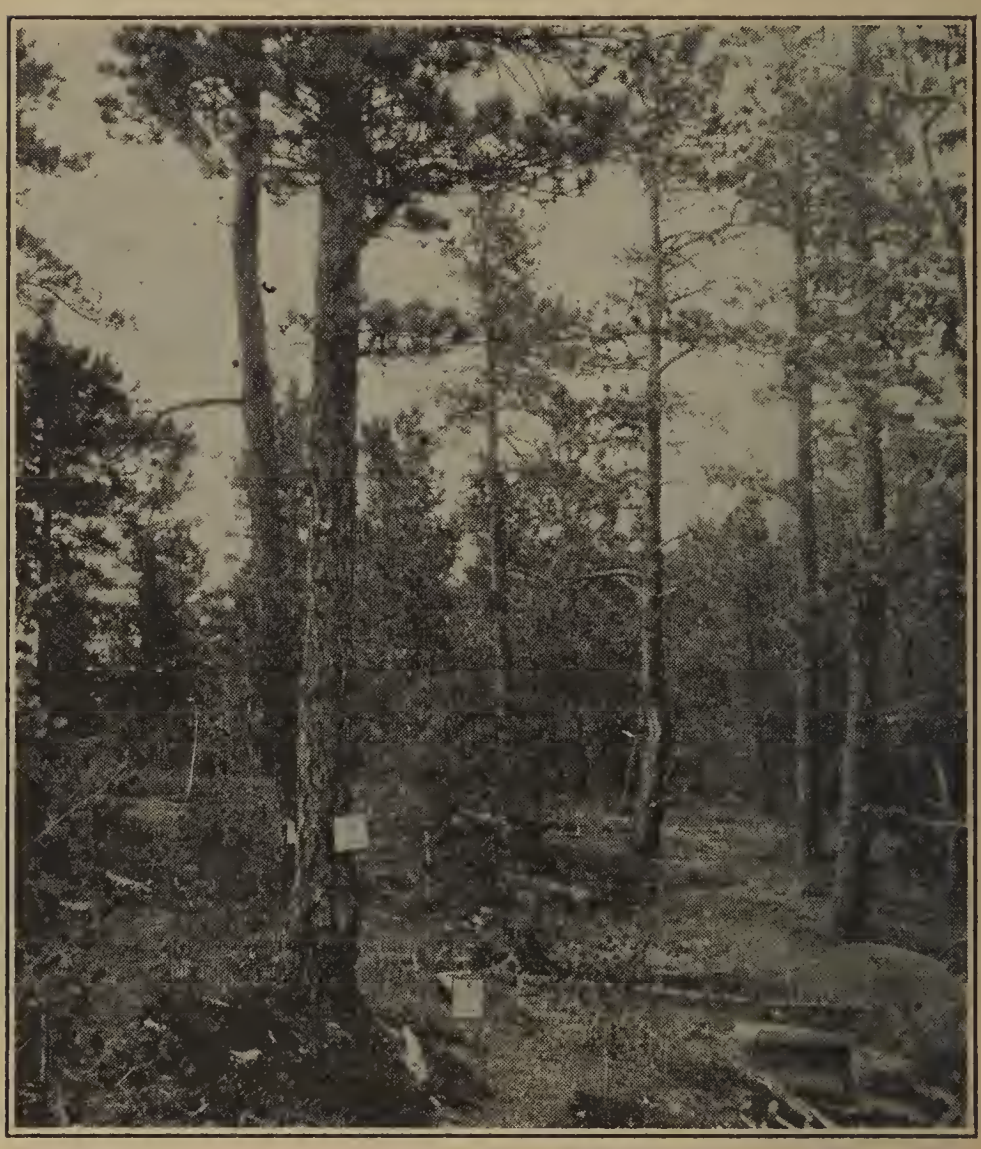
F-30175-A

Aspen, a short-lived tree in the Pikes Peak region, forms elsewhere in Colorado dense stands of amazing beauty

The evergreens all belong to one great family sometimes called the "pine family," which, as shown by fossils, has been in existence since early geological ages. It is not a serious error to call all evergreens "pines," but it is best to call them "conifers," because the habit of bearing the seeds in cones is characteristic of them all. Even the berry of the juniper is a "cone," its segments in most species being completely grown together.

Looking from the station toward the south slope, the one on which the sun shines most directly, you can see a forest of western yellow

pine (*Pinus ponderosa*). This is a heat-loving tree and is more often found on the lower slopes of the mountains, where the temperature is higher. At this elevation it flourishes only on such warm south slopes as this. The tree has a rather heavy appearance due to its large limbs and coarse needles. The needles are the tree's principal distinguishing feature and set it apart from all other conifers of the region. They are four to six inches long and are grouped together in "bundles" of two or three. Yellow pine seed is discharged from the cones late in the fall before the cones become detached from the tree. Cones found on the ground will invariably be empty, but by pressing on one of the segments, or scales, the two large pits where the seed rested until ripe can easily be seen.



F-38349-A

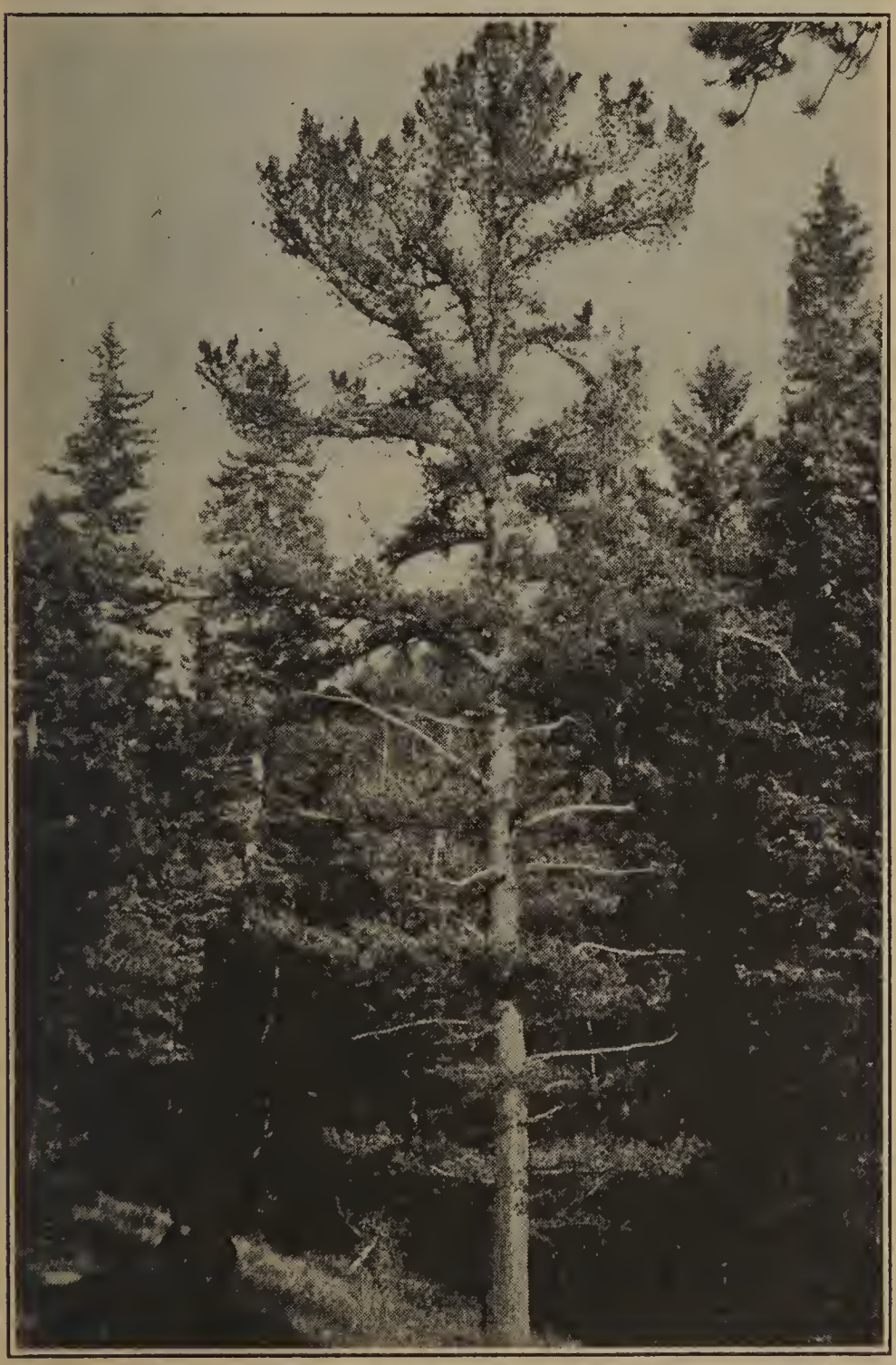
Typical western yellow pine forest of the Rocky Mountain region

Among the yellow pines, and scatteringly on all slopes and at all elevations, you will find an occasional limber pine (*Pinus flexilis*). This tree is peculiarly versatile, able to grow under many different conditions, because of the large size of its seed and its strong seedlings. Limber pine may be distinguished by its light gray bark and by its fine, almost silky needles which nearly always occur five to a bundle. It is a "poor relation" of the eastern white pine, bearing a slight resemblance but

never attaining any great size, and of little value except for fuel.

The only tree with which one might confuse limber pine is the bristlecone pine (*Pinus aristata*), which occurs up toward timberline and usually on rocky ridges. This tree also has needles in bundles of five, but they are shorter and stiffer than limber pine needles, and nearly always covered with tiny specks of pitch. The cones are prickly, each scale having a sharp hook on its outer extremity, which gives the tree its name. It is also sometimes called "fox-tail" pine, because of the long slender twigs clothed with needles, which resemble the brush of the fox.

One tree which occurs very sparingly in the Pikes Peak region, though it is common northward and westward in Colorado and Wyoming, is the lodgepole pine (*Pinus contorta*), which derives its name from the characteristically dense stands of long, slender poles, like so many



F-201829

Limber pine is usually a poor tree—note the tufted character of the foliage

Indian lodge poles, in which it usually grows. This tree has been planted extensively around the Experiment Station, and grows well, even though for some reason it appears unable to reproduce itself here naturally.

"Thick as the hair on a collie's back" characterizes these typical forests of lodgepole pine saplings in Colorado and northward

Lodgepole pine is distinguished by the yellow-green color of the foliage, by needles 2 to 4 inches long, usually in bundles of two, and by small, hard cones which cling to the branches for years without opening or dropping their seeds. Sometimes these cones cling so long that they are entirely buried in the wood, and are found, mummified, when blocks of wood are split open. This ability to retain its cones and seeds is very valuable to the tree when fire occurs in the forest. Though all of the old trees may be killed, the cones are generally unharmed and are opened by the heat. The seeds fall to the ground, and a new forest is started at once.

The piñon of the foothills (*Pinus edulis*), completes the list of true pines of the region. This is a small scrubby tree with needles about an inch long which reaches its northern limit here but is very common in the Southwest. It

is useful only for fuel and for its seeds, or nuts, which are large enough to be an important article of food for the poorer inhabitants of the Southwest, and appear in distant markets as a delicacy. Unshelled, they are about the size of a shelled Spanish peanut. The cones are small and rough, each cone bearing only a few of these large seeds. The semihard shells of the seeds have a slightly resinous flavor and must be disposed of, if the meat is to be enjoyed. The Mexicans who consume many piñon seeds become very adept in feeding whole seeds in at one side of the mouth while a steady stream of empty shells flows out at the other side.

F-87646

Engelmann spruce has a scaly or flaky bark, by which it may be distinguished from blue spruce with its ridged bark

Common companions of the piñon are two or three species of junipers, close relatives of the eastern juniper, or "red cedar." The various western junipers are difficult to distinguish. Some individuals have quite silvery foliage, and others are of a narrow cylindrical form as regular as though trimmed with shears. The layman will best be satisfied to call them all "junipers." The junipers have awl-shaped leaves about ½-inch long, sometimes pressed close to the twigs and sometimes spreading and very prickly. All have berries, some of which require two years to mature.

In the Pikes Peak region the junipers are found sparingly up to about 9,000 feet, while still higher there occurs another species which always grows as a low-spreading bush, and is called "ground juniper."

The spruces, true firs, and Douglas fir should now be recognized. The spruces are distinguished by needles, attached singly on all sides of the twigs, which on close examination will be seen to be four-sided, and sharp-pointed. In the famous Colorado blue spruce (*Picea pungens*) the needles are, if anything, a little longer, stiffer, and more prickly than in the Engelmann spruce (*Picea engelmanni*); but this is not a certain means of identification, nor does the blue color certainly distinguish the blue spruce from Engelmann's and from Douglas fir, both of which are sometimes very blue.

The most certain characteristic of the blue spruce is the length of the cones, which is 3 or 4 inches. But there is another characteristic always apparent and detected at a glance when one becomes accustomed to it. On the main trunk of the blue spruce there are a number of tiny twigs, only a few inches long, in addition to, and usually between, the main whorls of branches. These twigs keep pushing out on the stem for many years, and after the stem becomes large and the twigs die they give it an unkempt, unbrushed appearance. The stem of Engelmann spruce on the other hand, has none of these adventitious twigs. It is smooth and clean, the bark beginning to peel off at an early age in round, thin flakes.

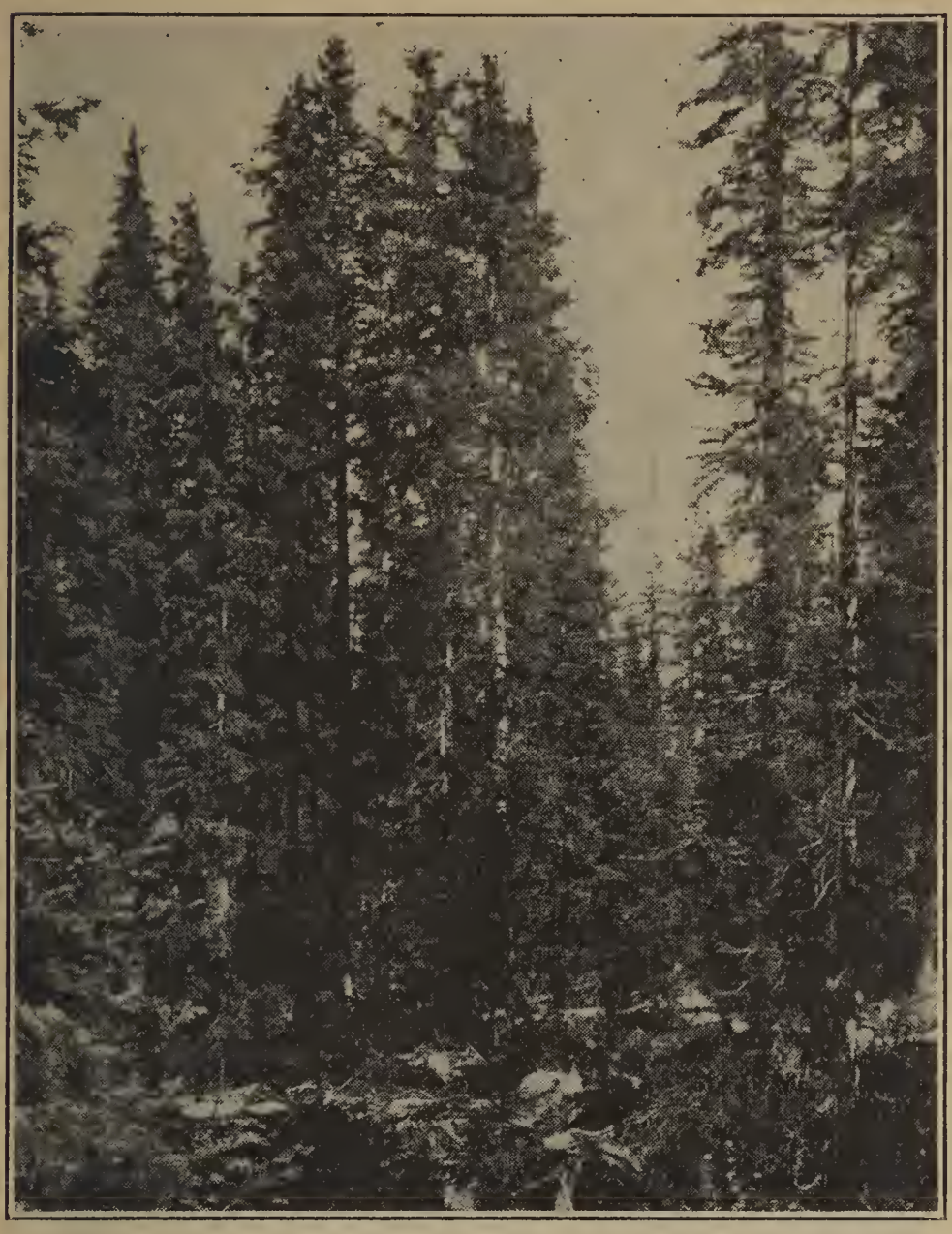
Blue spruce occurs mainly in the bottoms of canyons below the 9,000 foot elevation and hardly ever out on the hillsides. Engelmann spruce occurs in the canyons above 8,500 or 9,000 feet. As one goes higher this spruce is found making extensive forests on all slopes and aspects, up to timberline.

The cones of Engelmann spruce are only slightly more than an inch long. These small cones may usually be seen clinging near the extreme tips of the larger trees. In the early summer they are bright red.

Engelmann spruce forms the finest timber stands in Colorado, dense forests occurring at high elevations, with individual trees 50 inches in diameter. In spite of having only 60 to 90 days growing season, it grows faster than any other species. Trees 500 years old are not uncommon.

There is a fine clump of blue spruces just inside the Experiment Station gate (see p. 9),

and another clump on the slope to the right of the road, but here the species stops, and from here upward Engelmann spruce entirely takes its place.



F-21886-A

To be productive a spruce forest must be cleared of mature trees and dead timbers. On the back cover of this folder is shown an example of the untouched spruce forest

Throughout the world the true firs are companions of the spruces, and are often called "balsams." This symbiosis, or living together, is so common as to lead to the belief that the one is necessary to the existence of the other. One might speculate on that till doomsday without discovering the secret. However, in the Pikes Peak region alpine fir (*Abies lasiocarpa*) occurs very sparingly with the spruce, and abundantly in other parts of Colorado. A few specimens may be seen on the trail into the Bottomless Pit. The tree will be readily distinguished from spruce by its nearly white, smooth bark, becoming furrowed (never scaly) only when the stem approaches a foot in diameter. The leaves, also, instead of being square and pointed, are flat and blunt. They tend to turn upward on the twigs, so that it appears as though none were attached to the lower side of the twigs.

If one looks at the end of any twig of a true fir, except in the early spring when twigs are growing rapidly, he will always find there three blunt, shiny, resin-coated buds.

F-201832

This young white or "silver" fir shows the erect cones in the top and also the long needles usually erect

The white fir (*Abies concolor*), locally known as "silver fir," is much like the alpine fir, except that its foliage is a pale pea-green, and the needles often 2 inches or more long. It grows at the lower elevations, on hillsides with yellow pine and Douglas fir, and in the canyons with blue spruce. Its association with the pine and Douglas fir violates all the rules of conduct for well-behaved true firs. The light color of the foliage makes the silver fir a beautiful tree, and besides this it usually bears, on the uppermost twigs, a cluster of large, erect cones, pale green on some trees, but more often a deep, rich purple. When the cones of a fir ripen, the scales fall off, leaving the stalks or cores of the cones still standing upright, and strongly suggestive of Christmas candles in the tops of the trees.

Lastly we come to the Douglas fir (*Pseudotsuga taxifolia*) which is neither fir nor spruce, but possibly a close relation of the hemlocks. Douglas fir is one of the most widespread trees in the Pikes Peak region, and there is evidence that it formerly composed vast and splendid forests in many parts of Colorado and Wyoming, but that these forests have been almost exterminated by fires of bygone centuries. Remnants of the fir forests are often found but in many cases lodgepole pine has taken their place. Douglas fir in the Rocky Mountains, though inferior to its western brother, which reaches such magnificent proportions on the Pacific coast, is nevertheless one of our most valuable trees, its wood being very durable and highly prized for railroad ties and posts.

F-201831

Douglas fir. The plumed cones, a distinguishing mark of the genus Pseudotsuga, are found on the terminals of the branchlets

There are two features of Douglas fir which make it readily distinguishable from all other conifers. At the end of a twig one will always find a single cone-shaped, sharp-pointed bud, brownish red in color. Only rarely is there more than one bud. On the branches, after the tree is 8 or 10 feet tall, one will nearly always find dry cones which are light and papery in texture. Between the smooth, round scales of these cones, there project narrower, papery bracts, three-pronged at the tips. No other cones have this feature. While the cones are young (say until July) the cones themselves are purple and the 3-pronged bracts are green, creating a colorful contrast.

Douglas fir occurs generally at middle elevations (8,000–9,000 feet), but also at low elevations on cool, northerly aspects.

Other Matters of Interest in the Pike National Forest

(Headquarters, Colorado Springs)

Monument nursery, Monument, Colo., where are raised the million young trees planted each spring in the Pike National Forest, as well as trees for planting in several other forests.

Mountain peaks.—Pikes Peak, 14,109 feet; Torreys, 14,336 feet; Grays, 14,341 feet; and Bierstadt, 14,046 feet. The most popular of the lesser peaks is Devil's Head, 9,348 feet, a good hike from the foot to the fire-lookout station on the top.

Principal roads in the forest.—Victory Highway, Pikes Peak Ocean-to-Ocean Highway, Mount Evans Highway, Pikes Peak Auto Highway, State Highway No. 35, Mount Herman Road, and Curley Mountain Highway.

Recreation.—Fishing in all larger streams and lakes. Deer may be hunted in season and outside of refuges, also bear. Mountain sheep and elk may be hunted by the camera hunter only. Public camp grounds are located on all main roads.

National Forests in Colorado

The following are the national forests in Colorado, with the area of each in acres and the location of the forest headquarters:

Arapaho (680,021), Hot Sulphur Springs, Colo.
Cochetopa (930,220), Salida, Colo.
Colorado (1,150,010), Fort Collins, Colo.
Grand Mesa (670,799), Grand Junction, Colo.
Gunnison (951,310), Gunnison, Colo.
Hayden (72,000), Encampment, Wyo.
Holy Cross (1,213,500), Glenwood Springs, Colo.
La Sal (26,674), Moab, Utah.
Leadville (1,054,764), Leadville, Colo.
Montezuma (811,620), Mancos, Colo.
Pike (1,256,112), Colorado Springs, Colo.
Rio Grande (1,221,140), Monte Vista, Colo.
Routt (811,826), Steamboat Springs, Colo.
San Isabel (651,200), Pueblo, Colo.
San Juan (1,449,000), Durango, Colo.
Uncompahgre (860,180), Delta, Colo.
White River (919,070), Glenwood Springs, Colo.

Six Rules for Preventing Fire in the Forest

1. Matches.—Be sure that your match is out. Break it in two before you throw it away.

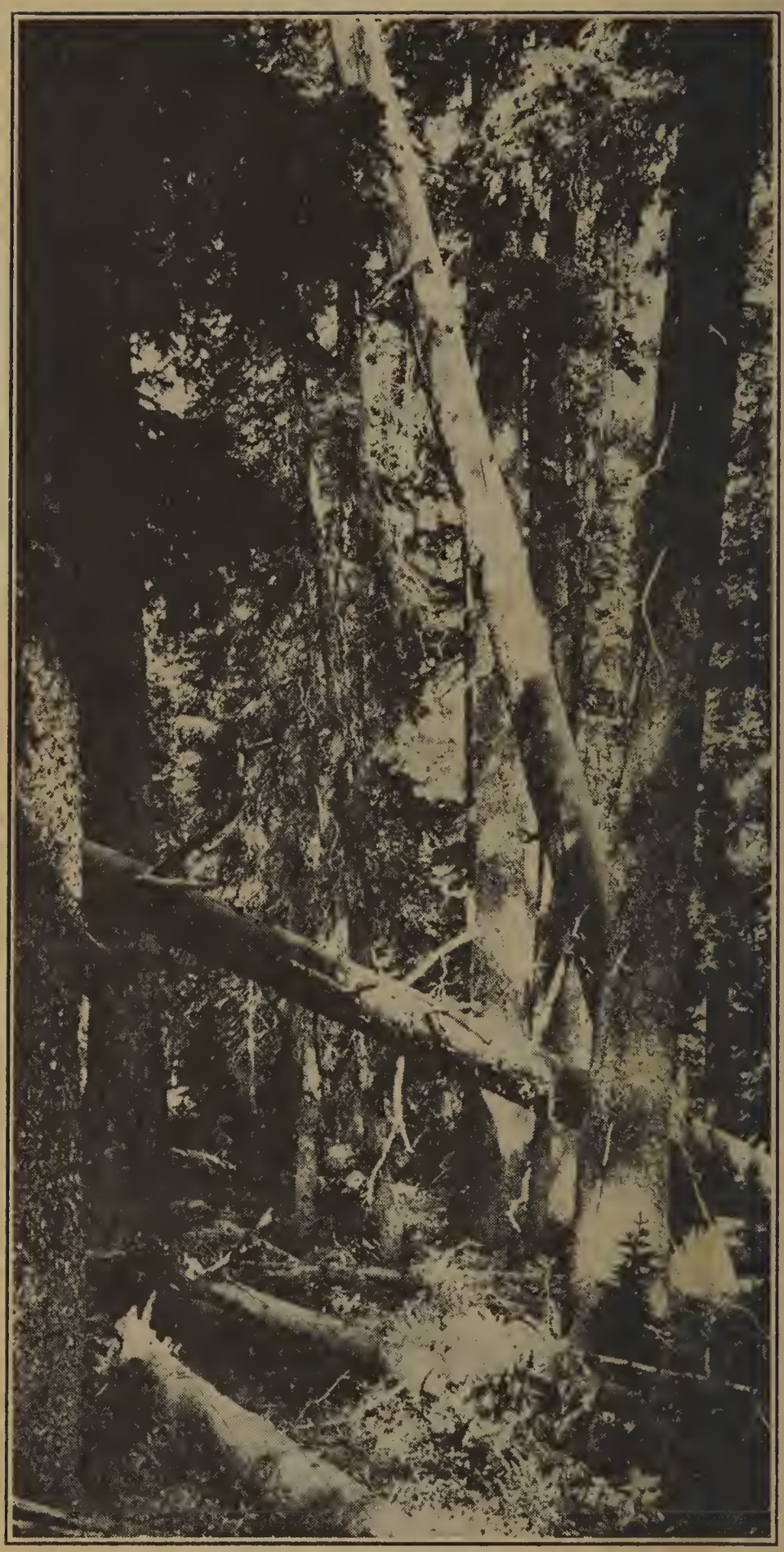
2. Tobacco.—Be sure that pipe ashes and cigar or cigarette stubs are dead before throwing them away. Never throw them into brush, leaves, or needles.

3. Making camp.—Before building a fire, scrape away all inflammable material from a spot 5 feet in diameter. Dig a hole in the center, and in it build your camp fire. Keep your fire small. Never build it against trees or logs or near brush.

4. Breaking camp.—Never break camp until your fire is out—dead out.

5. Brush burning.—Never burn brush or slash in windy weather or while there is the slightest danger that the fire will get away.

6. How to put out a camp fire.—Stir the coals while soaking them with water. Turn small sticks and drench both sides. Wet the ground around the fire. If you can't get water, stir in dirt and tread down until packed tight over and around the fire. Be sure the last spark is dead.



"This is the forest primeval!"

F-21879-A

ADDITIONAL COPIES
OF THIS PUBLICATION MAY BE PROCURED FROM
THE SUPERINTENDENT OF DOCUMENTS
GOVERNMENT PRINTING OFFICE
WASHINGTON, D. C.
AT
10 CENTS PER COPY

▽